

HIGHLIGHTED ARTICLES

Biodiversity redistribution under climate change: Impacts on ecosystems and human well-being

Science (14.23)

Methane emissions from the Marcellus Shale in southwestern Pennsylvania and northern West Virginia based on airborne measurements

Journal of Geophysical Research - Atmospheres (3.318)

Linking ecosystem processes to communities of practice through commercially fished species in the Gulf of Alaska

ICES Journal of Marine Science (2.801)

Improving growth estimates for Western Atlantic bluefin tuna using an integrated modeling approach

Fisheries Research (1.903)

Inter-nesting movements and habitat–use of adult female Kemp’s Ridley turtles in the Gulf of Mexico

PLOS ONE (3.057)

Why has the relationship between Indian and Pacific Ocean decadal variability changed in recent decades?

Journal of Climate (4.31)

Genetic and individual assignment of tetraploid green sturgeon with SNP assay data

Conservation Genetics (2.040)

CROSS LINE OFFICE ARTICLES

More reliable coastal SST forecasts from the North American multimodel ensemble

Climate Dynamics (4.619)

ADDITIONAL ARTICLES

NMFS Publications

Measuring the abundance, distribution, and life history diversity of Coho salmon (*Oncorhynchus kisutch*) in two recently recolonized tributaries to the Elwha River

Transactions of the American Fisheries Society (1.469)

Applying a new ensemble approach to estimating stock status of marine fisheries around the world

Conservation Letters (7.126)

Oceanographic influences on the distribution and relative abundance of market squid paralarvae (*Doryteuthis palescens*) off the Southern and Central California coast

Marine Ecology (1.138)

Deliberate downstream drift: The importance of flow-assisted migration for European grayling (*Thymallus thymallus*) during early life stages in large rivers

Journal of Fish Biology (1.658)

Vertical movements of juvenile Sablefish (*Anoplopoma fimbria*) in coastal Southeast Alaska

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Evaluating the consequences of salmon nutrients for riparian organisms: Linking condition metrics to stable isotopes

Ecology and Evolution (2.537)

Using hydroacoustics to describe pelagic fish distribution in the Penobscot Estuary, Maine

Transactions of the American Fisheries Society (1.469)

New perspectives on the feeding ecology and trophic dynamics of fishes

Environmental Biology of Fishes (1.404)

Variability in age and size at maturation, reproductive longevity, and long-term growth dynamics for Kemp's ridley sea turtles in the Gulf of Mexico

PLOS ONE (3.057)

Identification of multiple genetically distinct populations of Chinook salmon (*Oncorhynchus tshawytscha*) in a small coastal watershed

Environmental Biology of Fishes (1.404)

The importance of standardization for biodiversity comparisons: a case study using autonomous reef monitoring structures (ARMS) and metabarcoding to measure cryptic diversity on Mo'orea coral reefs, French Polynesia

PLoS ONE (3.057)

Estimating total mortality rates from mean lengths and catch rates in non-equilibrium situations

Transactions of the American Fisheries Society (1.469)

Measuring capital value in a commercial fishery: A distance function approach

Marine Policy (2.610)

OAR Publications

Seasonal cycle of cross-equatorial flow in the central Indian Ocean

Journal of Geophysical Research- Oceans (3.44)

Strong intraseasonal variability of meridional currents near 5°N in the eastern Indian Ocean - Characteristics and causes

Journal of Physical Oceanography (2.345)

Population genetic structure and comparative diversity of smallmouth bass *Micropterus dolomieu*: Congruent patterns from two genomes

Journal of Fish Biology (1.658)

Size-resolved characterization of the polysaccharidic and proteinaceous components of sea spray aerosol

Atmospheric Environment (3.062)

CO₂ exchange and evapotranspiration across dryland ecosystems of southwestern North America

Global Change Biology (8.444)

Water column and cold seep exploration of the Cascadia Margin

Oceanography (3.883)

Emissions of volatile organic compounds (VOCs) from concentrated animal feeding operations (CAFOs): Chemical compositions and separation of sources

Atmospheric Chemistry and Physics (5.114)

Observing system experiments with the hourly-updating Rapid Refresh model using GSI hybrid ensemble/variational data assimilation

Monthly Weather Review (3.248)

Extreme waves in the British Virgin Islands during the last centuries before 1500 CE

Geosphere (2.573)

The not-so-silent world: Measuring Arctic, Equatorial, and Antarctic soundscapes in the Atlantic Ocean

Deep Sea Research Part I: Oceanographic Research Papers (2.684)

Parallelization and Performance of the NIM Weather Model on CPU, GPU and MIC Processors

Bulletin of the American Meteorological Society (7.929)

Evaluation of ground-based black carbon measurements by filter-based photometers at two Arctic sites

Geophysical Research-Atmospheres (3.44)

Snow-level estimates using operational polarimetric weather radar measurements

Journal of Hydrometeorology (3.511)

NESDIS Publications

Solar signatures and eruption mechanism of the August 14, 2010 coronal mass ejection (CME)

Journal of Space Weather and Space Climate (2.846)

OTHER REPORTS, BOOK CHAPTERS, AND INTERNAL PUBLICATIONS

NOS

Mapping Habitat Change in Saipan Lagoon, Commonwealth of the Northern Mariana Islands (CNMI)

NCCOS Technical Memorandum

Spatial Patterning in the Sea: Mapping and Quantifying Seascape Patterns

Seascape Ecology: Taking Landscape Ecology Into the Sea (Book Chapter)

HIGHLIGHTED ARTICLES

Biodiversity redistribution under climate change: impacts on ecosystems and human well-being

Science (14.23)

G. T. Pecl, M. B. Araújo, J. D. Bell, J. Blanchard, T. C. Bonebrake, I. C. Chen, T. D. Clark, R. K. Colwell, F. Danielsen, B. Evengård, L. Falconi, S. Ferrier, S. Frusher, R. A. Garcia, **R. B. Griffis (NMFS/OST)**, A. J. Hobday, C. Janion-Scheepers, M. A. Jarzyna, S. Jennings, J. Lenoir, H. I. Linnetved, V. Y. Martin, P. C. McCormack, J. McDonald, N. J. Mitchell, T. Mustonen, J. M. Pandolfi, N. Pettorelli, E. Popova, S. A. Robinson, B. R. Scheffers, J. D. Shaw, C. J. B. Sorte, J. M. Strugnell, J. M. Sunday, M. N. Tuanmu, A. Vergés, C. Villanueva, T. Wernberg, E. Wapstra, S. E. Williams

- The distributions of Earth's species are changing at accelerating rates with human-driven changes in the planet's climate and ocean conditions.
- This global re-distribution of biodiversity is already altering the composition of ecosystems and the vital services ecosystem's provide.
- Climate-driven shifts in species distributions are expected to have significant impacts on ecosystems and the people, communities, businesses, economies and nations that depend on them.

Distributions of the Earth's species are changing at accelerating rates, increasingly driven by human-mediated climate change. Such changes are already altering the composition of ecological communities, but beyond conservation of natural systems, how and why does this matter? We review evidence that climate-driven species redistribution at regional to global scales is impacting ecosystem functioning, human well-being, and the dynamics of climate change itself. Production of natural resources required for food security, patterns of disease transmission, and processes of carbon sequestration are all altered by changes in species distribution.

Consideration of these effects of biodiversity redistribution is critical, yet lacking in most mitigation and adaptation strategies, including the United Nation's Sustainable Development Goals.

Publication date: March 31, 2017

Available online: <https://doi.org/10.1126/science.aai9214>

Methane emissions from the Marcellus Shale in southwestern Pennsylvania and northern West Virginia based on airborne measurements

Journal of Geophysical Research - Atmospheres (3.318)

X. Ren, D. L. Hall, T. Vinciguerra, S. E. Benish, P. R. Stratton, D. Ahn, J. R. Hansford, **M. D. Cohen (OAR/ARL)**, S. Sahu, H. He, C. Grimes, R. J. Salawitch, S. H. Ehrman, and R. R. Dickerson

- Significant methane emissions of $\sim 37 \text{ kg s}^{-1}$ were observed from a 4235 km^2 area of the southwestern Marcellus Shale region.
- We estimate a $\text{mean} \pm 1\sigma$ methane leak rate of $(3.9 \pm 0.4)\%$ from oil and natural gas operations in the SW Marcellus Shale with a lower limit of 1.5% and an upper limit of 6.3%.
- Our best estimate of the leak rate exceeds the 2.4% breakeven point relative to coal combustion for the global warming potential of methane over a 20-year time horizon. The production of energy from methane extracted from our surveyed area with current technologies is a climate detriment, if over the next two decades our measured leak rate is representative of typical conditions for extraction.

Natural gas production in the US has increased rapidly over the past decade, along with concerns about methane (CH_4) leakage (total fugitive emissions) and climate impacts. Quantification of CH_4 emissions from oil and natural gas (O&NG) operations is important for establishing scientifically sound, cost-effective policies for mitigating greenhouse gases. We use aircraft measurements and a mass balance approach for three flight experiments in August and September 2015 to estimate CH_4 emissions from O&NG operations in the southwestern Marcellus Shale region. We estimate the $\text{mean} \pm 1\sigma$ CH_4 emission rate as $36.7 \pm 1.9 \text{ kg CH}_4 \text{ s}^{-1}$ (or $1.16 \pm 0.06 \text{ Tg CH}_4 \text{ yr}^{-1}$) with 59% coming from O&NG operations. We estimate the $\text{mean} \pm 1\sigma$ CH_4 leak rate from O&NG operations as $3.9 \pm 0.4\%$ with a lower limit of 1.5% and an upper limit of 6.3%. This leak rate is broadly consistent with the results from several recent top-down studies, but higher than the results from a few other observational studies as well as in the US EPA CH_4 emission inventory. However, a substantial source of CH_4 was found to contain little ethane (C_2H_6), possible due to coalbed CH_4 emitted either directly from coalmines or from wells drilled through coalbed layers. Although recent regulations requiring capture of gas from the completion-venting step of the hydraulic fracturing appear to have reduced losses, our study suggests that for a 20-yr time scale, energy derived from the combustion of natural gas extracted from this region will require further controls before it can exert a net climate benefit compared to coal.

Publication date: April 2017

Available online: <http://onlinelibrary.wiley.com/doi/10.1002/2016JD026070/epdf>

Linking ecosystem processes to communities of practice through commercially fished species in the Gulf of Alaska

ICES Journal of Marine Science (2.801)

S. Zador (NMFS/AKFSC), S. Gaichas (NMFS/NEFSC), S. Kasperski (NMFS/AKFSC), C. L. Ward, R. Blake, N. C. Ban, A. Himes-Cornell, and Z. Koehn

- This study demonstrates the ability to link from environmental drivers to human community within a single, simple modeling framework, providing a solid foundation for more complex modeling.
- Environmental signals can affect human communities of practice and how fishery management decisions might affect ecosystem components aside from target species.
- Species interactions matter—perturbing single species models gave one set of results, but results from the same perturbation in the merged multispecies model differed substantially.

Marine ecosystems are complex, and there is increasing recognition that environmental, ecological and human systems are linked inextricably in coastal regions. The purpose of this paper was to integrate environmental, ecological and human dimensions information important for fisheries management into a common analytical framework. We then used the framework to examine the linkages between these traditionally separate subject areas. We focused on synthesis of linkages between the Gulf of Alaska marine ecosystem and human communities of practice, defined as different fisheries sectors. Our specific objective was to document the individual directional linkages among environmental, ecological, and human dimensions variables in conceptual models, then build qualitative network models to perform simulation analyses to test how bottom-up and top-down perturbations might propagate through these linkages. We found that it is both possible and beneficial to integrate environmental, ecological, and human dimensions information important for fisheries into a common framework. First, the conceptual models allowed us to synthesize information across a broad array of data types, representing disciplines such as ecology and economics that are more commonly investigated separately, often with distinct methods. Second, the qualitative network analysis demonstrated how ecological signals can propagate to human communities, and how fishery management measures may influence the system. Third, we found that incorporating multi-species interactions changed

outcomes because the merged model reversed some of the ecological and human outcomes compared to single species analyses. Overall, we demonstrated the value of linking information from the natural and social sciences to better understand complex social-ecological systems, and the value of incorporating ecosystem-level processes into a traditionally single species management framework. We advocate for conceptual and qualitative network modelling as efficient foundational steps to inform ecosystem-based fisheries management.

Acceptance date: March 14, 2017

Improving growth estimates for Western Atlantic bluefin tuna using an integrated modeling approach

Fisheries Research (1.903)

L. Ailloud, **M. V. Laretta**, A. Hanke, W. Golet, **R. Allman (NMFS/SEFSC)**, M. Siskey, D. Secor, and J. Hoenig

- Growth parameter estimates play a central role in the stock assessment of bluefin tuna and are used to calculate spawning potential ratio and biological reference points. They are needed to convert historical catch-at-size data into catch-at-age data, using cohort slicing, and to estimate weight at age.
- Preliminary analyses comparing cohort slicing results using growth parameters from the two different models showed that using the Richards growth parameter estimates resulted in higher contributions of very young and very old fish in the catch-at-age estimates compared to previous growth models.
- Estimates of variability in size-at-age could be used to improve the cohort slicing procedure by adjusting the length bounds used to assign ages to individual fish. The updated growth model of the species is likely to affect the aging of individuals as well as length-based assessment models.
- Having reliable estimates of growth is particularly important for determining stock productivity and associated reference points used for management advice.

Advances in modeling growth using tag-recapture data and progress in otolith ageing procedures allowed improved fitting of the Western Atlantic bluefin tuna growth curve. Growth parameters were derived from an integrated analysis of tag-recapture data and otolith age-length data using the “Aires-da-Silva-Maunders-Schaefer-Fuller with correlation” (AMSFc) framework, which models growth such

that parameter estimates from each data source are directly comparable. The otolith data consisted of a sample of 4045 otoliths for which ages were estimated using tested and consistent protocols and conventions designed to avoid bias. Strict data quality control measures were applied to the tagging data for quality assurance and a subsample of 1118 records were retained for use in the analysis. Two forms of the Schnute growth model were considered: the Richards model and the von Bertalanffy model. The Richards curve appears to provide a better fit. Both curves follow a similar trajectory until age 16, after which they diverge considerably. The Richards model supports a lower mean asymptotic length ($L_{\infty} = 271.0$ cm FL) than the model currently used in the stock assessment ($L_{\infty} = 314.9$ cm FL).

Publication date: March, 2017

Available online:

<http://www.sciencedirect.com/science/article/pii/S0165783617300504>

Inter-nesting movements and habitat–use of adult female Kemp’s Ridley turtles in the Gulf of Mexico

PLOS ONE (3.057)

D. J. Shaver, K. M. Hart, I. Fujisaki, D. Bucklin, A. R. Iverson, C. Rubio, T. Backof, P. M. Burchfield, R. G. Diaz Miron, **P. H. Dutton, A. Frey** (NMFS/SWFSC), J. Peña, D. Gomez Gamez, H. J. Martinez, J. Ortiz

- New inter-nesting habitat ranges were defined for Kemp’s ridley turtles in the Gulf of Mexico (14-19 m deep, 6-11 km from shore), suggesting nearshore Gulf waters are critical habitat during this time.
- These waters were occupied by a large portion of female Kemp’s ridleys during each nesting season, but unknown movements between these nesting grounds and foraging areas still remain.
- There is strong overlap between this newly defined critical inter-nesting habitat and user groups, such as shrimp trawlers and oil platforms. International waters are also crossed, suggesting management requires cooperation across many groups.

Breeding habitats are not well defined for many marine species. We used satellite telemetry and switching state-space modeling (SSM) to define inter-nesting habitat used by Kemp’s ridley turtles (*Lepidochelys kempii*) in the Gulf of Mexico. Turtles were tagged after nesting at Padre Island National Seashore, Texas, USA from

1998 through 2013 (PAIS; n = 60); Rancho Nuevo, Tamaulipas, Mexico during 2010 and 2011 (RN; n = 11); and Tecolutla, Veracruz, Mexico during 2012 and 2013 (VC; n = 11). Inter-nesting habitat lies in nearshore western Gulf of Mexico waters in the USA and Mexico with mean water depth of 14 to 19 m within a mean distance to shore of 6 to 11 km as estimated by 50% kernel density estimate, α -Hull, and minimum convex polygon methodologies. Turtles tracked during the inter-nesting period moved on average 18 km/day and a mean total distance of 399 km; mean home ranges occupied were 727 to 2984 km². Our results indicate that these nearshore Gulf waters represent a critical inter-nesting habitat for this species, where threats such as shrimp trawling and oil and gas platforms also occur. A large portion of adult females occupies this habitat for months during each nesting season. However, there is a gap in our understanding of dates when these turtles depart from foraging grounds and arrive in waters off the nesting beach, and thus of the total duration of time spent in these waters, which highlights the need for tracking adult females from foraging grounds to nesting beaches. Furthermore, the concentration of inter-nesting habitat for this species in nearshore waters of the western Gulf of Mexico in both the USA and Mexico demonstrates that international cooperation is necessary to protect essential inter-nesting habitat for this imperiled species.

Publication date: March 20, 2017

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Why has the relationship between Indian and Pacific Ocean decadal variability changed in recent decades?

Journal of Climate (4.31)

L. Dong and M. J. McPhaden (OAR/PMEL)

- Prior to 1985, sea surface temperature (SST) variations associated with Indian Ocean basin mode (IOB) and the interdecadal Pacific oscillation (IPO) were positively correlated, but after 1985 there was less synchrony between the two.
- Evidence suggests that enhanced external forcing, particularly from anthropogenic greenhouse gases, led to the change in relationship between SST and IOB and IPO.

Both the Indian and Pacific Oceans exhibit prominent decadal time scale variations in sea surface temperature (SST), linked dynamically via atmospheric and oceanic

processes. However, the relationship between SST in these two basins underwent a dramatic transformation beginning around 1985. Prior to that, SST variations associated with the Indian Ocean basin mode (IOB) and the interdecadal Pacific oscillation (IPO) were positively correlated, whereas afterward they were much less clearly synchronized. Evidence is presented from both observations and coupled state-of-the-art climate models that enhanced external forcing, particularly from increased anthropogenic greenhouse gases, was the principal cause of this changed relationship. Using coupled climate model experiments, it is shown that without external forcing, the evolution of the IOB would be strongly forced by variations in the IPO. However, with strong external forcing, the dynamical linkage between the IOB and the IPO weakens so that the negative phase IPO after 2000 is unable to force a negative phase IOB-induced cooling of the Indian Ocean. This changed relationship in the IOB and IPO led to unique SST patterns in the Indo-Pacific region after 2000, which favored exceptionally strong easterly trade winds over the tropical Pacific Ocean and a pronounced global warming hiatus in the first decade of the twenty-first century.

Publication date: March 1, 2017

Available online: <http://journals.ametsoc.org/doi/10.1175/JCLI-D-16-0313.1>

Genetic and individual assignment of tetraploid green sturgeon with SNP assay data

Conservation Genetics (2.040)

E. C. Anderson, T. C. Ng, E. D. Crandall, J. C. Garza (NMFS/SWFSC)

- This study describes the development of novel genetic markers and methodology for analysis of green sturgeon.
- The stock identification of bycatch from groundfish fisheries finds that majority of bycatch is from the ESA-listed southern DPS of green sturgeon.

Polyploid organisms pose substantial obstacles to genetic analysis, as molecular assay data are usually difficult to evaluate in a Mendelian framework. Green sturgeon (*Acipenser medirostris*) is a tetraploid species and is facing significant conservation challenges, including bycatch in ocean fisheries. We present here novel molecular genetic assays and analytical methodology for green sturgeon that allow discrimination of fish from the two visually indistinguishable distinct population segments (DPSs), and also provide individual-specific genetic tags. We show how the relative fluorescence intensity data from a standard quantitative PCR

assay, designed for a biallelic single nucleotide polymorphism, can be grouped into “genotype categories” using standard analytical software and post-processing manipulation. We then show how these genotype category data can be used to discriminate green sturgeon from the southern DPS, which is protected under the US Endangered Species Act, and the northern DPS, which is not. We also show how these data can be used to reliably identify individual green sturgeon, and can therefore be used in capture/recapture analyses. Both types of identification are extremely accurate even when fewer than half of the assays are successfully called. We then apply these new techniques to show that proportions of the two green sturgeon DPSs are extremely different in the two major fishery areas where they are encountered as bycatch. While these assays and methods do not provide data that can be used in pedigree-based analyses, they are an important advance in the application of genetic analysis to conservation and management of polyploid organisms.

Acceptance date: March 20, 2017

CROSS LINE OFFICE ARTICLES

More reliable coastal SST forecasts from the North American multimodel ensemble
Climate Dynamics (4.619)

G. Hervieux (OAR/ESRL), M. Alexander (OAR/ESRL), C. Stock (OAR/GFDL), M. Jacox (NMFS/SWFSC), K. Pegion, E. Becker (NWS/CPC), F. Castruccio, D. Tommasi (NMFS/SWFSC)

- Provides a comparative assessment of forecast skill for a multi-model ensemble in numerous large marine ecosystems

The skill of monthly sea surface temperature (SST) anomaly predictions for large marine ecosystems (LMEs) in coastal regions of the United States and Canada is assessed using simulations from the climate models in the North American Multimodel Ensemble (NMME). The forecasts based on the full ensemble are generally more skillful than predictions from even the best single model. The improvement in skill is particularly noteworthy for probability forecasts that categorize SST anomalies into upper (warm) and lower (cold) terciles. The ensemble provides a better estimate of the full range of forecast values than any individual model, thereby correcting for the systematic over-confidence (under-dispersion) of predictions from an individual model. Probability forecasts,

including tercile predictions from the NMME, are used frequently in seasonal forecasts for atmospheric variables and may have many uses in marine resource management.

Publication date: March 30, 2017

Available online: <https://link.springer.com/article/10.1007/s00382-017-3652-7>

ADDITIONAL ARTICLES

NMFS Publications

Measuring the abundance, distribution, and life history diversity of Coho salmon (Oncorhynchus kisutch) in two recently recolonized tributaries to the Elwha River
Transactions of the American Fisheries Society (1.469)

M. Liermann, G. R. Pess, M. McHenry, J. R. McMillan, M. Elofson, T. R. Bennett(NMFS/NWFSC), R. Moses

- Differing habitats within the same watershed can lead to immediate differences in life history strategies for recolonizing Coho salmon
- Warmer stream temperatures resulted in earlier emergence of salmon fry by 2 to 4 weeks.

In 2012 the Elwha River dam was breached restoring access of anadromous salmonids to the middle Elwha river (between the two breached dams), including two distinct tributaries. While comparable in size, Indian Creek is considerably less steep than Little River (average 1% vs. 5%), and has a warmer stream temperature regime due to its source, Lake Sutherland. During and after breaching, Coho salmon were relocated to these tributaries from the lower Elwha river (below the dams) providing an opportunity to see how genetically similar individuals would respond to two different habitats. Within the first year there were differences in life histories for the two tributaries. Indian Creek produced 4 to 5 times greater Coho salmon smolt out-migrant densities in spite of having similar redd densities. Coho salmon fry out-migrant densities were similar between the two tributaries.

Consistently warmer stream temperatures in Indian Creek resulted in earlier Coho salmon fry emergence of 2 to 4 weeks and warmer spring and summer rearing conditions. Even with these differences in life history we did not find a size differences in summer Coho salmon parr captured in the two tributaries. We hypothesize our sampling of Indian Creek was not representative of the entire

Creek and larger fish which spawned in other locations of the Elwha River may have immigrated into the more desirable Indian Creek habitats to rear. Differences in habitat conditions at the scale of tributaries within the same watershed for a newly recolonizing Coho salmon population can result in immediate differences in life history strategies.

Accepted date: March 3, 2017

Applying a new ensemble approach to estimating stock status of marine fisheries around the world

Conservation Letters (7.126)

A. A. Rosenberg, K. M. Kleisner, J. Afflerbach, S. C. Anderson, M. Dickey-Collas, A. B. Cooper, **M. J. Fogarty**, E.A. Fulton, N.L. Gutiérrez, **K. J. W. Hyde (NMFS/NEFSC)**; E. Jardim, O. P. Jensen, T. Kristiansen, C. Longo, C. V. Minto-Vera, C. Minto, I. Mosqueira, G. C. Osio, D. Ovando, E. R. Selig, J. T. Thorson, J. C. Walsh, and Y. Ye

- This project presents a new modeling approach for data-limited stocks to assess fisheries catch.
- This is a reproducible method that is broadly applicable to a range of stocks.

The exploitation status of marine fisheries stocks worldwide is of critical importance for food security, ecosystem conservation, and fishery sustainability. Applying a suite of data-limited methods to global catch data, combined through an ensemble modeling approach, we provide quantitative estimates of exploitation status for 785 fish stocks. Fifty six percent (439 stocks) are below BMSY and of these, 261 are estimated to be below 80% of the BMSY level. While the 178 stocks above 80% of BMSY are conventionally considered “fully exploited”, stocks staying at this level for many years, forego substantial yield. Our results enable managers to consider more detailed information than simply a categorization of stocks as “fully” or “over” exploited. Our approach is reproducible, allows consistent application to a broad range of stocks, and can be easily updated as new data become available. Applied on an ongoing basis, this approach can provide critical, more detailed information for resource management for more exploited fish stocks than currently available.

Acceptance date: March 20, 2017

Oceanographic influences on the distribution and relative abundance of market squid paralarvae (Doryteuthis paleoscens) off the Southern and Central California coast

Marine Ecology (1.138)

J. E. Van Noord and E. Dorval (NMFS/SWFSC)

- Analyzes the link between ENSO events and how that can alter the abundance, distribution, and timing of spawning and recruitment.
- Greatest paralarval densities were associated with cool SST, moderate zooplankton concentrations and low chlorophyll-a concentrations.

Market squid (*Doryteuthis opalescens*) are ecologically and economically important to the California Current Ecosystem, but populations undergo dramatic fluctuations that greatly affect food web dynamics and fishing communities. These population fluctuations are broadly attributed to 5–7-years trends that can affect the oceanography across 1,000 km areas; however, monthly patterns over kilometer scales remain elusive. To investigate the population dynamics of market squid, we analysed the density and distribution of paralarvae in coastal waters from San Diego to Half Moon Bay, California, from 2011 to 2016. Warming local ocean conditions and a strong El Niño event drove a dramatic decline in relative paralarval abundance during the study period. Paralarval abundance was high during cool and productive La Niña conditions from 2011 to 2013, and extraordinarily low during warm and eutrophic El Niño conditions from 2015 to 2016 over the traditional spawning grounds in Southern and Central California. Market squid spawned earlier in the season and shifted northward during the transition from cool to warm ocean conditions. We used a general additive model to assess the variability in paralarval density and found that sea surface temperature (SST), zooplankton displacement volume, the log of surface chlorophyll-a, and spatial and temporal predictor variables explained >40% of the deviance (adjusted r^2 of .29). Greatest paralarval densities were associated with cool SST, moderate zooplankton concentrations and low chlorophyll-a concentrations. In this paper we explore yearly and monthly trends in nearshore spawning for an economically important squid species and identify the major environmental influences that control their population variability.

Acceptance date: February 12, 2017

Deliberate downstream drift: the importance of flow-assisted migration for European grayling (Thymallus thymallus) during early life stages in large rivers
Journal of Fish Biology (1.658)

C. van Leeuwen, T. Tokk, T. O. Haugen, **P. M. Kiffney (NMFS/NWFSC)**, and J. Museth

- Few studies have examined the movement of juvenile fish in large river systems and whether this movement is an active search for rearing habitat or passive controlled by water flow.
- We quantified drift of juvenile Arctic grayling in a large Norwegian river fragmented by dams.
- There was strong evidence that juvenile movement was an active choice seeking high quality rearing habitat; therefore, river systems fragmented by dams effective management should account for movement by both adults and juveniles.

Behaviour of early life stages of the salmonid European grayling (*Thymallus thymallus*) was investigated by assessing (i) the timing of larval downstream movement from spawning areas, (ii) the depth at which larvae moved, and (iii) the distribution of juvenile fish during summer in two large connected river systems in Norway. Trapping of larvae moving downstream and electrofishing surveys revealed that European grayling larvae emerging from the spawning gravel moved downstream predominantly during night, despite light levels sufficient for orientation in the high-latitude study area. Larvae moved in the water mostly at the bottom layer close to the substrate, while drifting debris was caught in all layers of the water column. Few young-of-the-year still resided in the study area in autumn, suggesting large-scale downstream movement. Together, these observations advocate that there may be a deliberate, active component to downstream movement of European grayling during early life stages. This research signifies the importance of longitudinal connectivity for European grayling in Nordic large river systems. Human alterations of flow regimes and the construction of reservoirs for hydropower may not only affect the movement of adult fish, but may already interfere with active movement behaviour of fish during early life stages.

Acceptance date: March 22, 2017

Vertical movements of juvenile Sablefish (Anoplopoma fimbria) in coastal Southeast Alaska

Marine and Coastal Fisheries (1.442)

K. M. Coutr  (NMFS/AKFSC), A. H. Beaudreau, **D. Courtney (NMFS/SEFSC)**, F. J. Mueter, **P. W. Malecha (NMFS/AKFSC)**, **T. L. Rutecki (NMFS/AKFSC)**

- This manuscript is the first to describe the vertical movements of juvenile Sablefish in the wild using telemetry.
- Sablefish stocks in Alaska are declining and the factors affecting recruitment are not well understood. This study, linked with diet information for juvenile sablefish in Southeast Alaska, suggests that movements may be related to feeding events on pelagic prey such as Pacific Herring.

Diel vertical migration is commonly associated with pelagic fish species, but demersal fishes may also undertake vertical movements while managing foraging tradeoffs during their vulnerable juvenile stage. We examined fine-scale vertical movements of age-0 juvenile Sablefish (*Anoplopoma fimbria*) to better understand behavioral patterns that may affect their survival in nearshore habitats. Thirteen juvenile Sablefish (mean fork length (FL) 241.9 mm) were implanted with acoustic transmitters and monitored by two acoustic receivers from 5 October to 14 November 2003 within St. John Baptist Bay, Baranof Island, Alaska. The six fish that remained within range of the receivers spent the majority of time near the bottom, but made periodic vertical excursions. Generalized linear mixed effects models were used to determine the relationship between excursion frequency, tidal stage and diel period. For all fish, variation in excursion frequency was related to date and diel period, with the highest excursion frequency during dawn and day periods and the lowest at night. Over the 40-day period, excursion frequency increased to a peak at day 33, in early November. Generalized linear models for each individual fish supported the finding that the excursion behavior was primarily related to date and diel period, however tidal stage also explained variation in excursion frequency for three of the six individuals that remained within receiver range. This is the first study describing vertical migration of juvenile Sablefish in the wild and reveals that environmental conditions have the potential to influence the fine-scale movements of juvenile Sablefish within nearshore habitats.

Acceptance date: January 17, 2017

Evaluating the consequences of salmon nutrients for riparian organisms: Linking condition metrics to stable isotopes

Ecology and Evolution (2.537)

C. Vizza, B. L. Sanderson, H. J. Coe (NMFS/NWFSC), and D. T. Chaloner

- The nutrients that Pacific salmon (*Oncorhynchus* spp.) bring to freshwater streams influence adjacent riparian and terrestrial ecosystems, which are often traced through the food web using stable isotopes of carbon and nitrogen.
- The main goal of our study was to determine whether the quality or condition of terrestrial organisms is affected by inputs of salmon derived nutrients.
- Our results indicate that inputs of salmon do not currently increase the quality of riparian plants or the body condition of riparian invertebrates in these ecosystems, and that the stable isotope patterns among streams may reflect historical inputs of salmon.

Stable isotope ratios ($\delta^{13}\text{C}$ and $\delta^{15}\text{N}$) have been used extensively to trace nutrients from Pacific salmon, but salmon transfer more than carbon and nitrogen to stream ecosystems, such as phosphorus, minerals, proteins, and lipids. To examine the importance of these nutrients, metrics other than isotopes need to be considered, particularly when so few studies have made direct links between these nutrients and how they affect riparian organisms. Our study specifically examined $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ of riparian organisms from salmon and non-salmon streams in Idaho, USA, at different distances from the streams, and examined whether the quality of riparian plants and the body condition of invertebrates varied with access to these nutrients. Overall, quality and condition metrics did not mirror stable isotope patterns. Most notably, all riparian organisms exhibited elevated $\delta^{15}\text{N}$ in salmon streams, but also with proximity to both stream types suggesting that both salmon and landscape factors may affect $\delta^{15}\text{N}$. The amount of nitrogen incorporated from Pacific salmon was low for all organisms (<20%) and did not correlate with measures of quality or condition, probably due to elevated $\delta^{15}\text{N}$ at salmon streams reflecting historical salmon runs instead of current contributions. Salmon runs in these Idaho streams have been declining, and associated riparian ecosystems have probably seen about a 90% reduction in salmon-derived nitrogen since the 1950s. In addition, our results support those of other studies that have cautioned that inferences from

natural abundance isotope data, particularly in conjunction with mixing models for salmon-derived nutrient percentage estimates, may be confounded by biogeochemical transformations of nitrogen, physiological processes, and even historical legacies of nitrogen sources. Critically, studies should move beyond simply describing isotopic patterns to focusing on the consequences of salmon-derived nutrients by quantifying the condition and fitness of organisms putatively using those resources.

Publication date: February 1, 2017

Available online: <http://onlinelibrary.wiley.com/doi/10.1002/ece3.2697/full>

Using hydroacoustics to describe pelagic fish distribution in the Penobscot Estuary, Maine

Transactions of the American Fisheries Society (1.469)

M. O'Malley, **R. Saunders (NMFS/GARFO)**, J. Stevens, **J. M. Jech (NMFS/NEFSC)**, and **T. Sheehan (NMFS/NEFSC)**

- Temperate estuaries are dynamic environments that provide important habitat for diadromous, estuarine, and marine fish and they are difficult to survey with traditional techniques.
- Standardized surveys using a multi-frequency scientific echosounder conducted in the Penobscot River estuary (2012-2013) showed detectable spatial and temporal patterns of fish density and fish size across years, seasons, and with changing environmental conditions.
- This paper outlines a low cost and efficient approach for surveying similar environments.

Temperate estuaries are inherently variable and productive ecosystems that provide nursery habitat, migration pathways, and forage areas for diadromous, estuarine, and marine fish. We used multi-frequency scientific echosounders (SIMRAD EK60 split-beam 38 and 120 kHz) to describe the distribution of pelagic fish in the Penobscot Estuary (Maine, USA) in 2012 and 2013. Response differences between frequencies were used to distinguish fish from other biota. Acoustic area backscatter from echo integration (s_A [m^2/nmi^2], a common measure proportional to fish density), and target strength (TS [dB re 1 m^2], an acoustic measure of fish size) distributions varied with season and salinity. Overall s_A and TS distributions were similar in both years, with detectable spatial and temporal patterns. The highest s_A occurred in July of both years, when dense schools of fish were detected

in higher salinity areas of the lower estuary. The middle estuary had high s_A in April both years, particularly in the vicinity of the seawater/freshwater interface. The mixing area in the middle estuary strata appears to be important fish habitat; we found fish present in this area throughout the year. Fish of variable TS were using this mixing zone throughout the survey period. Upstream of the salinity mixing area in full freshwater, s_A was generally low. The majority (~77%) of discrete fish detected had TS < -42 dB. TS distributions varied seasonally, with the highest TS measurements occurring more frequently in April and May and lowest TS measurement occurring most frequently in July and August. This study demonstrates the efficacy of using a mobile hydroacoustic survey to assess pelagic fish distribution in a complex estuary and may provide a template for long-term monitoring in dynamic estuarine ecosystems.

Acceptance date: March 15, 2017

New perspectives on the feeding ecology and trophic dynamics of fishes

Environmental Biology of Fishes (1.404)

R. D. Brodeur (NMFS/NWFSC), B. E. Smith (NMFS/NEFSC), R. S. McBride (NMFS/NEFSC), R. Heintz (NMFS/AKFSC), E. Farley (NMFS/AKFSC)

- This special issue is a product of the symposium “GUTSHOP 2015: New perspectives on the feeding ecology and trophic dynamics of freshwater and marine fishes” from the 145th Annual Meeting of the American Fisheries Society, Portland, OR.

In summary, although there certainly have been many advances in the discipline of fish feeding ecology, there are many traditional aspects of this field that continue to be refined by researchers working in both freshwater and marine ecosystems. We hope that the papers presented here will serve as a stimulus for more in-depth work to come that examines the complexity of food web linkages and their role in fisheries management.

Publication date: April 6, 2017

Available online: <https://link.springer.com/article/10.1007/s10641-017-0594-1>

Variability in age and size at maturation, reproductive longevity, and long-term growth dynamics for Kemp's ridley sea turtles in the Gulf of Mexico

PLOS ONE (3.057)

L. Avens, L. R. Goshe, L. Coggins, D. J. Shaver, B. Higgins (NMFS/SEFSC), A. M. Landry, Jr., and R. Bailey

- Skeletochronological analysis of humerus bones was conducted on 333 stranded Gulf of Mexico Kemp's ridley turtles to provide age and size at sexual maturation data to understand recent, unexpected decreases in the recovery trajectory for nesting females of this endangered population.
- Age at sexual maturation was estimated between 11 and 13 years, with confidence intervals of 11.9 to 14.8 years.
- Long-term, significant decreases in somatic growth rates of juvenile and adult Kemp's ridley turtles may influence recruitment to the reproductive population, and differences in juvenile growth rates may differ between regions.
- The study found long-term, overall decreases and regional differences in growth rates of Kemp's ridley turtles, which have the potential to influence time to maturation, recruitment of nesting females, and observed population fluctuations.

Effective management of protected sea turtle populations requires knowledge not only of mean values for demographic and life-history parameters, but also temporal and spatial trends, variability, and underlying causes. For endangered Kemp's ridley sea turtles (*Lepidochelys kempii*) the need for baseline information of this type has been emphasized during attempts to understand causes underlying the recent truncation in the recovery trajectory for nesting females. To provide insight into variability in age and size at sexual maturation (ASM and SSM) and long-term growth patterns likely to influence population trends, we conducted skeletochronological analysis of humerus bones from 333 Kemp's ridleys stranded throughout the Gulf of Mexico (GOM) from 1993 to 2010. Ranges of possible ASMs (6.8 to 21.8 yr) and SSMs (53.3 to 68.3 cm straightline carapace length (SCL)) estimated using the "rapprochement" skeletal growth mark associated with maturation were broad, supporting incorporation of a maturation schedule in Kemp's ridley population models. Mean ASMs estimated from rapprochement and by fitting logistic, generalized additive mixed, and von Bertalanffy growth models to age and growth data ranged from 11 to 13 yr; confidence intervals for the logistic model predicted maturation of 95% of the population between 11.9 and 14.8 yr. Early juvenile somatic growth rates in the GOM were greater than those previously reported for the Atlantic, indicating potential for differences in

maturation trajectories between regions. Finally, long-term, significant decreases in somatic growth response were found for both juveniles and adults, which could influence recruitment to the reproductive population and observed nesting population trends.

Publication date: March 23, 2017

Available online: <http://dx.doi.org/10.1371/journal.pone.0173999>

Identification of multiple genetically distinct populations of Chinook salmon (Oncorhynchus tshawytscha) in a small coastal watershed

Environmental Biology of Fishes (1.404)

C. Davis, **J. C. Garza (NMFS/SWFSC)**, M. Banks

- Chinook salmon (*Oncorhynchus tshawytscha*) investigated within the Siletz River, a small coastal watershed in Oregon, USA.
- Two genetically distinct populations were identified in the basin, corresponding to early returning fish that spawn above a waterfall, a spring-run population, and later returning fish spawning below the waterfall, a fall-run population.
- This finding is an important consideration for management of the species, as spring-run populations generally only have been recognized in large watersheds, and highlights the need to evaluate population structure of salmon within smaller watersheds

Management and restoration planning for Pacific salmon is often characterized by efforts at broad multi-basin scales. However, finer-scale genetic and phenotypic variability may be present within individual basins and can be overlooked in such efforts, even though it may be a critical component for long-term viability. Here, we investigate Chinook salmon (*Oncorhynchus tshawytscha*) within the Siletz River, a small coastal watershed in Oregon, USA. Adult Chinook salmon were genotyped using neutral microsatellite markers, single nucleotide polymorphisms and "adaptive" loci, associated with temporal variation in migratory behavior in many salmon populations, to investigate genetic diversity based upon both spatial and temporal variation in migratory and reproductive behavior. Results from all three marker types identified two genetically distinct populations in the basin, corresponding to early returning fish that spawn above a waterfall, a spring-run population, and later returning fish spawning below the waterfall, a fall-run population. This finding is an important consideration for management of the

species, as spring-run populations generally only have been recognized in large watersheds, and highlights the need to evaluate population structure of salmon within smaller watersheds, and thereby increase the probability of successful conservation of salmon species.

Acceptance Date: March 22, 2017

The importance of standardization for biodiversity comparisons: A case study using autonomous reef monitoring structures (ARMS) and metabarcoding to measure cryptic diversity on Mo'orea coral reefs, French Polynesia

PLoS ONE (3.057)

E. Ransome, J. B Geller, M. Timmers, M. Leray, A. Mahardini, A. Sembiring, **A. G Collins (NMFS/OST)**, Christopher P Meyer

- Elucidating biodiversity through sound systematics is of foundational importance to ecosystem management.
- This paper describes methods related to measuring biodiversity that colonize Autonomous Reef Monitoring Structures. With over 1,500 such units deployed, many by NOAA, these methods are of great importance.

The advancement of metabarcoding techniques, declining costs of high-throughput sequencing and development of systematic sampling devices, such as autonomous reef monitoring structures (ARMS), have provided the means to gather a vast amount of diversity data from cryptic marine communities. However, such increased capability could also lead to analytical challenges if the methods used to examine these communities across local and global scales are not standardized. Here we compare and assess the underlying biases of four ARMS field processing methods, preservation media, and current bioinformatic pipelines in evaluating diversity from cytochrome c oxidase I metabarcoding data. Illustrating the ability of ARMS-based metabarcoding to capture a wide spectrum of biodiversity, 3,372 OTUs and twenty-eight phyla, including 17 of 33 marine metazoan phyla, were detected from 3 ARMS (2.607 m² area) collected on coral reefs in Mo'orea, French Polynesia. Significant differences were found between processing and preservation methods, demonstrating the need to standardize methods for biodiversity comparisons. We suggest the use of a standardized protocol (NOAA method) combined with DMSO preservation of tissues for sessile macroorganisms because it gives a more accurate representation of the underlying communities, is cost effective and prevents chemical restrictions for sample transportation. The

identification of sequence reads with $\geq 97\%$ similarity increased more than 7-fold (5.1% to 38.6%) using a geographically local barcode inventory, highlighting the importance of local species inventories. Phylogenetic approaches that assign higher taxonomic ranks accrued phylum identification errors (9.7%) due to sparse taxonomic coverage of the understudied cryptic coral reef community in public databases. However, a $\geq 85\%$ sequence identity cut-off provided more accurate results (0.7% errors) and enabled Phylum level identifications of 86.3% of the sequence reads. With over 700 ARMS deployed, standardizing methods and improving databases are imperative to provide unprecedented global baseline assessments of understudied cryptic marine species in a rapidly changing world.

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Available online: [http://iocwestpac.org/OA/29-](http://iocwestpac.org/OA/29-31%20Aug%2016/draft%20SOPs/ARMS/Ransome_ARMS_Methods_Paper.pdf)

[31%20Aug%2016/draft%20SOPs/ARMS/Ransome_ARMS_Methods_Paper.pdf](http://iocwestpac.org/OA/29-31%20Aug%2016/draft%20SOPs/ARMS/Ransome_ARMS_Methods_Paper.pdf)

Estimating total mortality rates from mean lengths and catch rates in non-equilibrium situations

Transactions of the American Fisheries Society (1.469)

Q. C. Huynh, T. Gedamke, **C. E. Porch** (NMFS/SEFSC), J. M. Hoenig, **J. F. Walter** (NMFS/SEFSC), **M. Bryan** (NMFS/AFSC), and **J. Brodziak** (NMFS/PIFSC)

- Extends Gedamke-Hoenig mean-length estimator to use indices of abundance.
- Demonstrates enhanced performance and utility of a data poor assessment technique

A series of estimates of total mortality rate, Z , can be obtained by using the Beverton-Holt non-equilibrium based approach of Gedamke and Hoenig (2006) on observations of population mean length over time (ML model). In contrast, only relative mortality rates, not absolute values, can be obtained from a time series of catch rate. We derive the transitional behavior of catch rate following a change in total mortality in the population. From this derivation, we develop a new method to estimate total mortality rates that utilizes both mean lengths and catch rates (MLCR model). Both ML and MLCR models assume constant recruitment in the population. We used a simulation study to test performance when recruitment is variable. Simulations over various scenarios of total mortality and recruitment variability show that there may be correlated residuals in the mean lengths and

catch rates arising from fluctuations in recruitment. However, the root mean square errors of the estimates of the total mortality and the change point, the year when mortality changed, are smaller in the MLCR model than in the ML model, indicating that the former can better account for variable recruitment. Both methods were then applied to Mutton Snapper *Lutjanus analis* in Puerto Rico to illustrate their potential application to assess data-limited stocks. The ML model estimated an increase in the mortality rate, but the MLCR model also estimated a subsequent reduction in mortality rate when the catch rate data were considered. Acceptance date: March 14, 2017

Measuring capital value in a commercial fishery: A distance function approach
Marine Policy (2.610)

R. Färe, S. Grosskopf, **J. Walden** (NMFS/NEFSC)

- Fishing vessel values can be estimated with publicly available data and easily constructed linear programming models.
- Prices for vessel attributes obtained from the models can be used to construct Lowe quantity indices of vessel capital value.

The term “overcapitalized” is frequently used to describe the condition of various fisheries, and to explain why a fishery is in poor condition from a stock status perspective. Often, the concept of overcapitalization is associated with the number of active vessels in a fishery. Although vessel counts are important, they do not fully capture investment or disinvestment in a fishery, and only serve as a crude proxy for a richer concept of fishing capital. A better measure to judge whether overcapitalization is occurring would be the change in capital value for vessels operating, or permitted in a fishery, relative to a benchmark value. Unfortunately, data do not always exist to measure vessel value and associated changes through time. This study presents a method for calculating vessel capital value using a distance function, publicly available vessel sale price data, and non-parametric programming methods. Estimates of value for vessel attributes returned by the distance function are then used to estimate a total value for currently permitted vessels in the northeast region of the United States, and to construct a capital value index for vessels active in the squid, mackerel and butterfish (SMB) fishery between 1996 and 2016. Findings show that the total value of commercially permitted vessels in the northeast region is estimated to be between \$606.6 and \$769.7 million (\$2016). Based on the constructed capital value index, the SMB

fishery has undergone a period of disinvestment marked by both declining vessel numbers and capital value.

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Available Online:

<http://www.sciencedirect.com/science/article/pii/S0308597X17300064>

OAR Publications

Seasonal cycle of cross-equatorial flow in the central Indian Ocean

Journal of Geophysical Research- Oceans (3.44)

Y. Wang and **M.J. McPhaden (OAR/PMEL)**

- Mean volume transport in the central Indian Ocean is southwards across the equator in approximate Sverdrup balance with the wind stress curl
- Evidence was also found for existence of a shallow equatorial roll consisting of northward wind-driven surface drift overlaying southward-directed subsurface transport
- Seasonal variations are characterized by cross equatorial transports

This study investigates the seasonal cycle of meridional currents in the upper layers of central equatorial Indian Ocean using acoustic Doppler current profiler (ADCP) and other data over the period 2004-2013. The ADCP data set collected along 80.5°E is the most comprehensive collection of direct velocity measurements in the central Indian Ocean to date, providing new insights into the meridional circulation in this region. We find that mean volume transport is southwards across the equator in the central Indian Ocean in approximate Sverdrup balance with the wind stress curl. In addition, mean westerly wind stress near the equator drives convergent Ekman flow in the surface layer and subsurface divergent geostrophic flow in the thermocline at 50-150 m depths. In response to a mean northward component of the surface wind stress, the maximum surface layer convergence is shifted off the equator to 0.75°N. Evidence is also presented for the existence of a shallow equatorial roll consisting of a northward wind-driven surface drift overlaying the southward-directed subsurface Sverdrup transport. Seasonal variations are characterized by cross equatorial transports flowing from the summer to the winter hemisphere in quasi-steady Sverdrup balance with the wind stress curl. In addition, semi-annually varying westerly monsoon transition winds lead to semi-annual enhancements of surface layer Ekman convergence and

geostrophic divergence in the thermocline. These results quantify expectations from ocean circulation theories for equatorial Indian Ocean meridional circulation patterns with a high degree of confidence given the length of the data records.

Acceptance date: March 16, 2017

Strong intraseasonal variability of meridional currents near 5°N in the eastern Indian Ocean - Characteristics and causes

Journal of Physical Oceanography (2.345)

G. Chen, W. Han, Y. Li, **M. J. McPhaden (OAR/PMEL)**, J. Chen, W. Wang, and D. Wang

- In-situ measurements reveal strong intraseasonal variability of meridional current, which far exceeds the mean flow and seasonal cycle and is associated with westward propagating eddy-like sea surface height anomalies
- Rossby waves propagate westward, causing sea surface height anomalies and the meridional current

This paper reports on strong intraseasonal upper-ocean meridional currents observed in the Indian Ocean between the Bay of Bengal (BOB) and the equator, and elucidates the underlying physical processes responsible for them. In-situ measurements from a subsurface mooring at 5°N, 90.5°E reveal strong intraseasonal variability of meridional current with an amplitude of $\sim 0.4 \text{ m s}^{-1}$ and a typical period of 30-50 days in the upper 150 m, which by far exceeds the magnitudes of the mean flow and seasonal cycle. Such prominent intraseasonal variability is however not seen in zonal current at the same location. Further analysis suggests that the observed intraseasonal flows are closely associated with westward propagating eddy-like sea surface height anomalies (SSHAs) along 5°N. The eddy-like SSHAs are largely manifestations of symmetric Rossby waves, which result primarily from intraseasonal wind stress forcing in the equatorial waveguide and reflection of the equatorial Kelvin waves at the eastern boundary. Since the wave signals are generally symmetric about the equator, similar variability is also seen at 5°S but with weaker intensity, due to the inclined coastline at the eastern boundary. The Rossby waves propagate westward, causing pronounced intraseasonal SSHA and meridional current in the upper ocean across the entire southern BOB between 84° and 94°E. They greatly weaken in the western Indian basin, but zonal currents near the equator remain relatively strong.

Publication date: March 13, 2017

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Population genetic structure and comparative diversity of smallmouth bass

Micropterus dolomieu: *Congruent patterns from two genomes*

Journal of Fish Biology (1.658)

C. A. Stepien (OAR/PMEL), S. I. Karsiotis, T. J. Sullivan, and K. E. Klymus

- High genetic variability is present in smallmouth bass across its northern native range as determined through microsatellite analysis
- Several factors probably lead to the genetic variability across its range including geographic isolation, territoriality, and site fidelity

Genetic diversity and divergence patterns of smallmouth bass *Micropterus dolomieu* spawning groups are analysed across its northern native range with mtDNA cytochrome b gene sequences and eight unlinked nuclear DNA microsatellite loci. Results reveal high levels of genetic variability and significant differences in allelic representation among populations (mtDNA: mean \pm s.e., $HD = 0.50 \pm 0.06$, mean \pm s.e., $\theta_{ST} = 0.41 \pm 0.02$ and microsatellites: mean \pm s.e., $HO = 0.46 \pm 0.03$, mean \pm s.e., $\theta_{ST} = 0.25 \pm 0.01$). The distributions of 28 variant mtDNA haplotypes, which differ by an average of 3.94 nucleotides (range = 1–8), denote divergent representation among geographic areas. Microsatellite data support nine primary population groups, whose high self-assignment probabilities likewise display marked divergence. Genetic patterns demonstrate: (1) high genetic diversity in both genomes, (2) significant divergence among populations, probably resulting from natal site homing and low lifetime migration, (3) support for three post-glacial refugia that variously contributed to the current northern populations, which remain evident today despite waterway connectivity and (4) a weak yet significant genetic isolation by geographic distance pattern, indicating that other processes affect the differences among populations, such as territoriality and site fidelity.

Accepted date: February 13, 2017

Available online: <http://onlinelibrary.wiley.com/doi/10.1111/jfb.13296/full>

Size-resolved characterization of the polysaccharidic and proteinaceous components of sea spray aerosol

Atmospheric Environment (3.062)

J. Y. Allera, J. C. Radway, W. P. Kilthau, D. W. Bothe, T. W. Wilson, R. D. Vaillancourt, **P. K. Quinn, D. J. Coffman (OAR/PMEL)**, B. J. Murray, and D. A. Knopf

- Proteinaceous gels and polysaccharidic transparent exopolymers are present in sub- and supermicron sea spray aerosol particles.
- Marine ambient particles are enriched in transparent exopolymer and proteinaceous material.

Dissolved organic polymers released by phytoplankton and bacteria abiologically self-assemble in surface ocean waters into nano-to micro-sized gels containing polysaccharides, proteins, lipids and other components. These gels concentrate in the sea surface microlayer (SML), where they can potentially contribute to sea spray aerosol (SSA). Sea spray is a major source of atmospheric aerosol mass over much of the earth's surface, and knowledge of its properties (including the amount and nature of the organic content), size distributions and fluxes are fundamental for determining its role in atmospheric chemistry and climate. Using a cascade impactor, we collected size-fractionated aerosol particles from ambient air and from freshly generated Sea Sweep SSA in the western North Atlantic Ocean together with biological and chemical characterization of subsurface and SML waters. Spectrophotometric methods were applied to quantify the polysaccharide-containing transparent exopolymer (TEP) and protein-containing Coomassie stainable material (CSM) in these particles and waters. This study demonstrates that both TEP and CSM in surface ocean waters are aerosolized with sea spray with the greatest total TEP associated with particles <180 nm in diameter and >5 000 nm. The higher concentrations of TEP and CSM in particles >5 000 nm most likely reflects collection of microorganism cells and/or fragments. The greater concentration of CSM in larger size particles may also reflect greater stability of proteinaceous gels compared to polysaccharide-rich gels in surface waters and the SML. Both TEP and CSM were measured in the ambient marine air sample with concentrations of $2.1 \pm 0.16 \mu\text{g xanthan gum equivalents (XG eq.) m}^{-3}$ and $14 \pm 1.0 \mu\text{g bovine serum albumin equivalents (BSA eq.) m}^{-3}$. TEP in Sea Sweep SSA averaged $4.7 \pm 3.1 \mu\text{g XG eq. m}^{-3}$ and CSM $8.6 \pm 7.3 \mu\text{g BSA eq. m}^{-3}$. This work shows the transport of marine biogenic material across the air-sea interface through primary particle emission and the first demonstration of particle size discriminated TEP and CSM characterization of SSA and ambient aerosol under field conditions.

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<http://www.sciencedirect.com/science/article/pii/S1352231017300699>

CO₂ exchange and evapotranspiration across dryland ecosystems of southwestern North America

Global Change Biology (8.444)

J. Biederman, R. Scott, T. Bell, D. Bowling, S. Dore, J. Garatuza-Payan, T. Kolb, **P. Krishnan**, D. Krofcheck, M. Litvak, G. Maurer, **T. Meyers (OAR/ARL)**, W. Oechel, S. Papuga, G. Ponce-Campos, J. Rodriguez, W. Smith, R. Vargas, C. Watts, E. Yezpe, M. Goulden

- The dryland ecosystems in southwest North America switch between a carbon sink/source with mean annual net ecosystem production varying from -350 to +330 g C m⁻² across sites with diverse vegetation types, contrasting with the more constant sink typically measured in mesic ecosystems.
- Results showed the contribution of this dryland region to variability of regional to global carbon dioxide exchange is up to 3 – 5 times larger than current estimates.

Global-scale studies suggest that dryland ecosystems dominate an increasing trend in the magnitude and interannual variability of the land CO₂ sink. However, such analyses are poorly constrained by measured CO₂ exchange in drylands. Here we address this observation gap with eddy covariance data from 25 sites in the water-limited Southwest region of North America with observed ranges in annual precipitation of 100 – 1000 mm, annual temperatures of 2 – 25 deg C, and records of 3 – 10 years (150 site-years in total). Annual fluxes were integrated using site specific ecohydrologic years to group precipitation with resulting ecosystem exchanges. We found a wide range of carbon sink/source function, with mean annual net ecosystem production (NEP) varying from -350 to +330 g C m⁻² 48 across sites with diverse vegetation types, contrasting with the more constant sink typically measured in mesic ecosystems. In this region, only forest dominated sites were consistent carbon sinks. Interannual variability of NEP, gross ecosystem production (GEP) and ecosystem respiration (Reco) was larger than for mesic regions, and half the sites switched between functioning as C sinks/C sources in wet/dry years. The sites demonstrated coherent responses of GEP and NEP to anomalies in annual evapotranspiration (ET), used here as a proxy for annually

available water after hydrologic losses. Notably, GEP and Reco were negatively related to temperature, both interannually within site and spatially across sites, in contrast to positive temperature effects commonly reported for mesic ecosystems. Models based on MODIS satellite observations matched the cross-site spatial pattern in mean annual GEP but consistently underestimated mean annual ET by ~50%. Importantly, the MODIS-based models captured only 20-30 % of interannual variation magnitude. These results suggest the contribution of this dryland region to variability of regional to global CO₂ exchange may be up to 3 – 5 times larger than current estimates.

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Water column and cold seep exploration of the Cascadia Margin
Oceanography (3.883)

R. Embley, N. Raineault, **S. Merle**, **T. Baumberger**, S. Seabrook, and **S. Hammond (OAR/PMEL)**

- On the R/V Falkor 2016 research cruise discoveries from the previous year were followed up on and focused also shifted to newly discovered hydrothermal vent sites and lava flows.
- The multidisciplinary science team confirmed that the back-arc ecosystems are distinct from the nearby volcanic arc hydrothermal systems.

During the 2016 Field Season aboard the R/V Falkor, David Butterfield from NOAA/PMEL and UW/JISAO, lead a team of scientists as they returned to the Mariana back-arc. This team was the first to use the new Schmidt Ocean Institute's ROV SuBastian. This year's research cruise followed up on discoveries made last year aboard the R/V Falkor and focused on those newly discovered hydrothermal vent sites and lava flows. The multidisciplinary science team confirmed that the back-arc ecosystems are distinct from the nearby volcanic arc hydrothermal systems. This cruise is part of a multi-year exploration and research project to understand the character of hydrothermal systems and biological connectivity in the Mariana region.

Publication date: March 2017

Available online: <https://tos.org/oceanography/issue/volume-30-issue-01-supplement>

Emissions of volatile organic compounds (VOCs) from concentrated animal feeding operations (CAFOs): Chemical compositions and separation of sources
Atmospheric Chemistry and Physics (5.114)

B. Yuan, M. M. Coggon, A. R. Koss, C. Warneke, S. Eilerman, J. Peischl, K. C. Aikin, T. B. Ryerson, and J. A. de Gouw (OAR/ESRL)

- VOC emissions mainly come from two sources: animals and their waste or feed storage and handling. However, the composition of what each source emits is different. For example, animals and their waste emit phenols and nitrogen-containing compounds such as ammonia, while the feed emits alcohols, carboxylic acids, and sulfur-containing compounds.
- The researchers found that the same animals (cows) give off different volatile organic compounds (VOCs) depending on their diet and other practices. For example, across the Front Range, beef cattle had higher levels of emissions than dairy cattle. Industry practices (e.g. feed additives) affect odor and atmospheric chemistry in and around feedlots.
- These results suggest that a better understanding of these processes—the sources and chemical composition of VOCs—could help industry target specific compounds and mitigate the impacts of emissions on air quality and human health, without affecting the productivity of the industry.

Concentrated animal feeding operations (CAFOs) emit a large number of volatile organic compounds (VOCs) to the atmosphere. In this study, we conducted mobile laboratory measurements of VOCs, methane (CH_4) and ammonia (NH_3) downwind of dairy cattle, beef cattle, sheep and chicken CAFO facilities in northeastern Colorado using a hydronium ion time-of-flight chemical-ionization mass spectrometer (H_3O^+ ToF-CIMS) that can detect numerous VOCs. Regional measurements of CAFO emissions in northeastern Colorado were also performed using the NOAA WP-3D aircraft during the Shale Oil and Natural Gas Nexus (SONGNEX) campaign. Alcohols and carboxylic acids dominate VOC concentrations and the reactivity of the VOCs with hydroxyl (OH) radicals. Sulfur-containing and phenolic species provide the largest contributions to in the odor activity values and the nitrate radical (NO_3) reactivity of VOC emissions, respectively. VOC compositions determined from mobile laboratory and aircraft measurements generally agree well with each other. The high time-resolution mobile measurements allow the separation of the sources of VOCs from different parts of the operations occurring within the facilities. We show that the emissions

of ethanol concentrations are primarily associated with feed storage and handling. Based on mobile laboratory measurements, we apply a multivariate regression analysis using NH_3 and ethanol as tracers to determine the relative importance of animal-related emissions (animal exhalation and waste) and feed-related emissions (feed storage and handling) for different VOC species. Feed storage and handling contribute significantly to emissions of alcohols, carbonyls, carboxylic acids and sulfur-containing species. Emissions of phenolic species and nitrogen-containing species are predominantly associated with animals and their waste.

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Available online: <http://www.atmos-chem-phys-discuss.net/acp-2016-1148/acp-2016-1148.pdf>

Observing system experiments with the hourly-updating Rapid Refresh model using GSI hybrid ensemble/variational data assimilation

Monthly Weather Review (3.248)

E. P. James and S. G. Benjamin (OAR/ESRL)

- The recently improving observation suite that includes hourly data especially from commercial aircraft, GOES satellite, surface stations, and radars provides an invaluable heterogeneous dataset to initialize rapidly-updating numerical weather prediction systems over North America.
- Improvements in data assimilation of these widely varying observation sources also contribute to ongoing improvement in skill for these short-term weather model predictions important for decision-makers related to aviation, energy, severe weather, and other applications.
- The increasing coverage of hourly observations from several sources, especially from commercial aircraft, and increasingly effective data assimilation contributes significantly to ongoing gains in rapidly updating model forecast skill.

A set of observation system experiments (OSEs) over 3 seasons using the hourly-updated Rapid Refresh (RAP) numerical weather prediction (NWP) assimilation/forecast system identifies the importance of the various components of the North American observing system for 3-12h RAP forecasts. Aircraft observations emerge as the strongest-impact observation type for wind, relative humidity (RH), and temperature forecasts, permitting a 15-30% reduction in 6h forecast error in the troposphere and lower stratosphere. Major positive impacts are

also seen from rawinsondes, GOES satellite cloud observations, and surface observations, with lesser but still significant impacts from GPS-PW observations, satellite atmospheric motion vectors (AMVs), and radar reflectivity observations. A separate experiment revealed that the aircraft-related RH forecast improvement was augmented by 50% due specifically to the addition of aircraft moisture observations. Additionally, observations from enroute aircraft and those from ascending or descending aircraft contribute approximately equally to overall forecast skill, with the strongest impacts in the respective layers of the observations. Initial results from these OSEs supported implementation of an improved assimilation configuration of boundary-layer pseudo-innovations from surface observations, as well as allowing the assimilation of satellite AMVs over land. The breadth of these experiments over the 3 seasons suggests that observation impact results are applicable to general forecasting skill, not just classes of phenomena in limited time periods.

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Extreme waves in the British Virgin Islands during the last centuries before 1500 CE

Geosphere (2.573)

B. F. Atwater, U. S. ten Brink, A. L. Cescon, N. Feuillet, Z. Fuentes, R. B. Halley, C. Nuñez, E. G. Reinhardt, J. H. Roger, Y. Sawai, M. Spiske, M. P. Tuttle, **Y. Wei (OAR/PMEL)**, and J. Weil-Accardo

- Presence of inland coral colonies on the island of Anegada indicate extreme, tsunami-like waves off Puerto Rico deposited these coral and other reef species up to 3 km inland.
- This study provides the first mapping and characterization of these inland reef species.

Extraordinary marine inundation scattered clasts southward on the island of Anegada, 120 km south of the Puerto Rico Trench, sometime between 1200 and 1480 calibrated years (cal yr) CE. Many of these clasts were likely derived from a fringing reef and from the sandy flat that separates the reef from the island's north shore. The scattered clasts include no fewer than 200 coral boulders, mapped herein for the first time and mainly found hundreds of meters inland. Many of

these are complete colonies of the brain coral *Diploria strigosa*. Other coral species represented include *Orbicella* (formerly *Montastraea*) *annularis*, *Porites astreoides*, and *Acropora palmata*. Associated bioclastic carbonate sand locally contains articulated cobble-size valves of the lucine *Codakia orbicularis* and entire conch shells of *Strombus gigas*, mollusks that still inhabit the sandy shallows between the island's north shore and a fringing reef beyond. Imbricated limestone slabs are clustered near some of the coral boulders. In addition, fields of scattered limestone boulders and cobbles near sea level extend mainly southward from limestone sources as much as 1 km inland. Radiocarbon ages have been obtained from 27 coral clasts, 8 lucine valves, and 3 conch shells. All these additional ages predate 1500 cal yr CE, all but 2 are in the range 1000–1500 cal yr CE, and 16 of 22 brain coral ages cluster in the range 1200–1480 cal yr CE. The event marked by these coral and mollusk clasts likely occurred in the last centuries before Columbus (before 1492 CE).

The pre-Columbian deposits surpass Anegada's previously reported evidence for extreme waves in post-Columbian time. The coarsest of the modern storm deposits consist of coral rubble that lines the north shore and sandy fans on the south shore; neither of these storm deposits extends more than 50 m inland. More extensive overwash, perhaps by the 1755 Lisbon tsunami, is marked primarily by a sheet of sand and shells found mainly below sea level beneath the floors of modern salt ponds. This sheet extends more than 1 km southward from the north shore and dates to the interval 1650–1800 cal yr CE. Unlike the pre-Columbian deposits, it lacks coarse clasts from the reef or reef flat; its shell assemblage is instead dominated by cerithid gastropods that were merely stirred up from a marine pond in the island's interior.

In their inland extent and clustered pre-Columbian ages, the coral clasts and associated deposits suggest extreme waves unrivaled in recent millennia at Anegada. Bioclastic sand coats limestone 4 m above sea level in areas 0.7 and 1.3 km from the north shore. A coral boulder of nearly 1 m³ is 3 km from the north shore by way of an unvegetated path near sea level. As currently understood, the extreme flooding evidenced by these and other clasts represents either an extraordinary storm or a tsunami of nearby origin. The storm would need to have produced tsunami-like bores similar to those of 2013 Typhoon Haiyan in the Philippines. Normal faults and a thrust fault provide nearby tsunami sources along the eastern Puerto Rico Trench.

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<http://geosphere.gsapubs.org/content/early/2017/03/17/GES01356.1.full.pdf+html>

The not-so-silent world: Measuring Arctic, Equatorial, and Antarctic soundscapes in the Atlantic Ocean

Deep Sea Research Part I: Oceanographic Research Papers (2.684)

S. M. Haver, H. Klinck, S. L. Nieukirk, H. Matsumoto, R. P. Dziak (OAR/PMEL), and J. L. Miksis-Olds

- Ocean ambient sound levels vary throughout the Atlantic Ocean, with the equatorial Atlantic near Ascension Island the highest recorded of 3 stations due to seismic oil and gas exploration.
- Ambient levels of sound vary more seasonally in polar regions than equatorial regions.
- Individual elements beget the seasonal and annual variability of Atlantic Ocean soundscapes in high latitudes.
- Both anthropogenic and natural contributions are made to the soundscapes of the Atlantic Ocean, with a need to understand the variability in both to properly manage species influenced by sound.

Anthropogenic noise in the ocean has been shown, under certain conditions, to influence the behavior and health of marine mammals. Noise from human activities may interfere with the low-frequency acoustic communication of many Mysticete species, including blue (*Balaenoptera musculus*) and fin whales (*B. physalus*). This study analyzed three soundscapes in the Atlantic Ocean, from the Arctic to the Antarctic, to document ambient sound. For 16 months beginning in August 2009, acoustic data (15–100 Hz) were collected in the Fram Strait (79°N, 5.5°E), near Ascension Island (8°S, 14.4°W) and in the Bransfield Strait (62°S, 55.5°W). Results indicate (1) the highest overall sound levels were measured in the equatorial Atlantic, in association with high levels of seismic oil and gas exploration, (2) compared to the tropics, ambient sound levels in polar regions are more seasonally variable, and (3) individual elements beget the seasonal and annual variability of ambient sound levels in high latitudes. Understanding how the variability of natural and man-made contributors to sound may elicit differences in ocean soundscapes is essential to developing strategies to manage and conserve marine ecosystems and animals.

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Parallelization and Performance of the NIM Weather Model on CPU, GPU and MIC Processors

Bulletin of the American Meteorological Society (7.909)

M. Govett, J. Rosinski, J. Middlecoff, T. Henderson, J. Lee, A. MacDonald, N. Wang, P. Madden, J. Schramm (OAR/ERSL), and A. Duarte

- The Non-hydrostatic Icosahedral Model (NIM) is the first and only weather or climate model able to run on Central Processing Units (CPU), Graphics Processing Units (GPU) and Many Integrated Cores (MIC) processors with a single source code.
- The NIM model, written in Fortran, runs 2 to 3 times faster on MIC and GPU chips than CPU processors.
- A cost-benefit analysis of NIM demonstrated a 2 times cost-benefit favoring GPU-enabled systems versus traditional CPU processors (MIC was not compared).

Next-generation super-computers containing millions of processors will require weather prediction models be designed and developed by teams of scientists, software engineers, and parallelization experts so they are portable and run efficiently on increasingly diverse HPC systems. The design and performance of the NIM global weather prediction model is described. NIM is a dynamical core designed to run on CPU, GPU and MIC processors. It demonstrates efficient parallel performance and scalability to tens of thousands of compute nodes, and has been an effective way to make comparisons between traditional CPU and emerging fine-grain processors. The design of the NIM also serves as a useful guide in the fine-grain parallelization of the FV3 model recently chosen by the NWS to become its next operational, global weather prediction model. This paper describes the code structure and parallelization of NIM using standards-compliant OpenMP and OpenACC directives. NIM uses the directives to support a single, performance-portable code that runs on CPU, GPU and MIC systems. Performance results are compared for five generations of computer chips including the recently released Intel Knights Landing and NVIDIA Pascal chips. Single and multi-node performance and scalability is also shown, along with a cost-benefit comparison based on vendor list prices.

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Available online: <http://dx.doi.org/10.1175/BAMS-D-15-00278.1>

Evaluation of ground-based black carbon measurements by filter-based photometers at two Arctic sites

Journal of Geophysical Research-Atmospheres (3.44)

P. R. Sinha, Y. Kondo, M. Koike, **J. A. Ogren (OAR/ESRL)**, A. Jefferson, T.E. Barrett, R. J. Sheesley, S. Ohata, N. Moteki, H. Coe, D. Liu, M. Irwin, P. Tunved, **P. K. Quinn (OAR/PMEL)**, and Y. Zhao

- The researchers evaluated the accuracy of black carbon (BC) measurements at Barrow, Alaska and NyÅlesund, Spitsbergen, in the Arctic.
- At Barrow, seasonally averaged black carbon mass concentrations decreased in winter and summer at a rate of $0.55 \pm 0.30 \text{ ng m}^{-3} \text{ yr}^{-1}$ during 1998 - 2015.
- We established seasonal variations of black carbon at the two sites and evaluated the causes of the inconsistency of the previously reported data.

Long-term measurements of the light absorption coefficient (babs) obtained with a particle soot absorption photometer (PSAP), babs (PSAP), have been previously reported for Barrow, Alaska, and Ny-Ålesund, Spitsbergen, in the Arctic.

However, the effects on babs of other aerosol chemical species co-existing with black carbon (BC) have not been critically evaluated. Furthermore, different mass absorption cross section (MAC) values have been used to convert babs to BC mass concentration ($\text{MBC} = \text{babs}/\text{MAC}$). We used a continuous soot monitoring system (COSMOS), which uses a heated inlet to remove volatile aerosol compounds, to measure babs [babs (COSMOS)] at these sites during 2012–2015. Field measurements and laboratory experiments have suggested that babs (COSMOS) is affected by about 9% on average by sea-salt aerosols. MBC values derived by COSMOS [MBC (COSMOS)] using a MAC value obtained by our previous studies agreed to within 9% with elemental carbon concentrations at Barrow measured over 11 months. babs (PSAP) was higher than babs (COSMOS), by 22% at Barrow (PM1) and by 43% at Ny-Ålesund (PM10), presumably due to the contribution of volatile aerosol species to babs (PSAP). Using babs (COSMOS) as a reference, we derived MBC (PSAP) from babs (PSAP) measured since 1998. We also established the seasonal variations of MBC at these sites. Seasonally averaged MBC (PSAP) decreased at a rate of about $0.55 \pm 0.30 \text{ ng m}^{-3} \text{ yr}^{-1}$. We also

compared MBC (COSMOS) and scaled MBC (PSAP) values with previously reported data and evaluated the degree of inconsistency in the previous data.

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Snow-level estimates using operational polarimetric weather radar measurements
Journal of Hydrometeorology (3.511)

S. Matrosov, R. Cifelli, A. White, and **T. Coleman (OAR/ESRL)**

- Snow-level information is important for weather forecasting. It helps to predict whether a precipitation event is likely to produce mostly rain in a watershed, which may lead to flash flooding, or if the precipitation will mostly fall as snow and may not have an immediate effect on streamflow.

In 2012, the National Weather Service upgraded its network of operational weather radars, which now also measure new radar variables that are useful for identifying melting layer—the region in the atmosphere where snow melts into rain. This melting layer region usually extends from several kilometers to several dozens of kilometers as seen along nearly horizontal operational radar beams. A new study in the April issue of the Journal of Hydrometeorology suggests an approach for using operational radar measurements to infer the vertical level (i.e., snow-level) in the atmosphere above/below which precipitation falls mostly as snow or rain.

Researchers from CIRES and ESRL's Physical Sciences Division compared the operational radar estimates of the snow-level, near the Oroville dam in California with results from a dedicated vertically-pointing NOAA Snow-Level Radar and found them to be in good agreement—typically within 160 m.

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NESDIS Publications

Solar signatures and eruption mechanism of the August 14, 2010 coronal mass ejection (CME)

Journal of Space Weather and Space Climate (2.846)

E. D'Huys, **D. B. Seaton (NESDIS/NCEI)**, A. De Groof, D. Berghmans, and S. Poedts

- This case study of an energetic solar eruption shows that both the signatures of eruptive events on the Sun, like solar flares, and the observations and tools available to forecasters cannot always provide adequate information to diagnose the potential space weather significance of an eruption.
- The physical mechanism behind an eruption, and the structure of the solar corona in the vicinity of an eruption, can lead to underestimates of risks.
- In the absence of robust, multi-wavelength and multi-viewpoint observations of the Sun, there is a danger that events of significance to space weather could be overlooked.

On August 14, 2010 a wide-angled coronal mass ejection (CME) was observed. This solar eruption originated from a destabilized filament that connected two active regions and the unwinding of this filament gave the eruption an untwisting motion that drew the attention of many observers. In addition to the erupting filament and the associated CME, several other low-coronal signatures that typically indicate the occurrence of a solar eruption were associated with this event. However, contrary to what was expected, the fast CME ($v > 900 \text{ km s}^{-1}$) was accompanied by only a weak C4.4 flare. We investigate the various eruption signatures that were observed for this event and focus on the kinematic evolution of the filament in order to determine its eruption mechanism. Had this solar eruption occurred just a few days earlier, it could have been a significant event for space weather. The risk of underestimating the strength of this eruption based solely on the C4.4 flare illustrates the need to include all eruption signatures in event analyses in order to obtain a complete picture of a solar eruption and assess its possible space weather impact.

Publication Date: March 8, 2017

Available Online: <https://doi.org/10.1051/swsc/2017006>

OTHER REPORTS, BOOK CHAPTERS, AND INTERNAL PUBLICATIONS

Mapping Habitat Change in Saipan Lagoon, Commonwealth of the Northern Mariana Islands (CNMI)

NCCOS Technical Memorandum

M. S. Kendall and **B. Costa (NOS/NCCOS)**

- Saipan Lagoon contains a complex mosaic of benthic habitats.

- A broad shift in habitat types occurs offshore of Garapan (at about 15° 13' 3'' latitude). North of Garapan, the Lagoon is mainly comprised of bare sand and gravel, and upright dead and live coral reef with mixed algae.
- South of Garapan, the dominant habitats shift to pavement with mixed algae and sand and gravel colonized by *Halodule uninervis* mixed with algae.
- This broad habitat transition occurs where the closest, clearly defined reef crests are about 2 kilometers to the north and south.

The lagoon along the western shore of Saipan encompasses a diverse coral ecosystem that plays a leading role in attracting nearly half a million tourists annually for snorkeling, diving, parasailing, kayaking, and use of personal watercraft. Understanding the present spatial distribution and extent of important lagoon habitats is needed for evaluating zoning scenarios, minimizing user conflicts, ensuring public safety, and preventing environmental degradation in the Lagoon. The main objective of this project was to support these decisions by producing new, highly detailed maps of the extent and distribution of the seafloor habitats within the Lagoon. Recent advancements in not only the spatial and spectral resolution of satellite imagery but also in computational power and complex mathematical models enable a new generation of map products. The result is a dramatic increase in map detail using a more objective, repeatable analysis. The performance and overall accuracy for the new habitat maps were high, allowing the map to be used with high levels of confidence for a variety of different applications.

Publication date: March 31, 2017

Available online: <https://coastalscience.noaa.gov/projects/detail?key=271>

Spatial Patterning in the Sea: Mapping and Quantifying Seascape Patterns
Seascape Ecology: Taking Landscape Ecology into the Sea (Book Chapter)

B. Costa (NOS/NCCOS), B. Walker, and J. Dijkstra

- Mapping seascape patterns enhances our ability to understand and sample the marine environment efficiently, enables us to bridge the gap between in situ and remotely sensed information, and explore the effect of changing scales on species and communities.
- A growing number of analytical techniques make it challenging to determine how to characterize and apply seascape maps and metrics efficiently and accurately.

- We present a stepwise operational framework discussing key considerations when mapping seascapes to help seascape ecologists characterize, quantify and analyze spatial patterning in the seascape.

Seascape maps describe the spatial and temporal distribution of physical and biological structure and conditions in the marine environment. Mapping these patterns enhances our ability to understand and sample the seascape efficiently. Seascape maps also enable us to bridge the gap between in situ and remotely sensed information, and explore the effect of changing scales on species and communities. While seascape maps are crucial data types in seascape ecology, they are often difficult to derive. Gaps in our knowledge about species distributions and behaviors make it challenging to choose environmental variables and scales that are ecologically relevant. No one sensor can map all seascape patterns under all environmental conditions, requiring that the sensors and platforms are chosen carefully. A growing number of analytical techniques make it challenging to determine how to characterize and apply seascape maps and metrics efficiently and accurately. We present a stepwise operational framework discussing key considerations when mapping seascapes to help seascape ecologist characterize, quantify and analyze spatial patterning in the seascape. This framework can be used to help evaluate seascape maps, determine best-fit for specific project goals, and to discern seascape patterns at scales that are ecologically relevant.

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